[0051] FIG. 35 is an isometric view of a multipole device in accordance with one aspect of thee present inventions.

[0052] FIG. 36 is a top plan view of the multipole device of FIG. 35.

[0053] FIG. 37 is a left side elevation view of the multipole device of FIG. 35.

[0054] FIG. 38 is a right end elevation view of the multipole device of FIG. 35.

[0055] FIG. 39 is a transverse section of the multipole device of FIG. 35 taken along line 39-39 in FIG. 36.

[0056] FIG. 40 is a center transverse section of the multipole device of FIG. 35 taken along 40-40 in FIG. 36.

[0057] FIG. 41 is a transverse section of the multipole device of FIG. 35 taken along line 41-41 in FIG. 36.

[0058] FIG. 42 is a longitudinal cross-section of an anchor pin in accordance with one aspect of one of the present inventions.

[0059] FIG. 43 is an isometric view of a complete multipole device in accordance with one aspect of the present inventions.

[0060] FIG. 44 is a top plan view of the device of FIG. 43.

[0061] FIG. 45 is a longitudinal cross section of the device of FIG. 43.

[0062] FIG. 46 is a schematic and longitudinal cross section of one embodiment of a mold assembly for producing an electrode and support combination in accordance with another aspect of one of the present inventions.

DETAILED DESCRIPTION OF THE INVENTION

[0063] The following specification taken in conjunction with the drawings sets forth the preferred embodiments of the present inventions in such a manner that any person skilled in the art can make and use the inventions. The embodiments of the inventions disclosed herein are the best modes contemplated by the inventors for carrying out the inventions in a commercial environment, although it should be understood that various modifications can be accomplished with the parameters of the present inventions.

[0064] Apparatus and methods are described which can improve the design, manufacture and/or operation of multipole or multi-electrode devices, for example that may be used for manipulating or transporting ions. They may be used to reduce the assembly tooling and/or

assembler handling. They may also reduce the cost of manufacture, especially with multiple electrode devices, give more flexibility in the design of such devices, or result in devices that are more robust and have better structural integrity. One or more aspects of these apparatus and methods may also be used to make smaller components and allow more flexibility in choosing the configuration of the component. By extruding, molding or otherwise forming the multipole profile, for example, such characteristics as rod precision, alignment and mounting may be built into the raw components. Additionally, design flexibility is increased and assembly process time is decreased. Furthermore, overall design robustness may be increased with fewer parts and fewer connections.

[0065] Part of the following discussion focuses on multipole ion guides, such as those that include quadrupole, hexapole and octapole ion guides, because these are among the useful applications, for example for an extruded multipole assembly. However, the concepts in the structures and methods are applicable to other designs, to other components in apparatus for manipulating or transporting ions, and other applications of multipole or multi-electrode devises. They are applicable, for example, to quadrupole electrode spectrometers and mass filters, collision cells, lenses, collisional cooling systems, multiple stage ion processing, ion beam transports, gas conductance limit tubes, linear ion traps or any devices with multiple electrodes or multiple electrical connections, especially where an electrical signal is applied to more than one electrode or component at the same time. In another part of the discussion, aspects of the inventions are discussed that are particularly useful to applications where precision is preferred. Applications that benefit from higher precision components include multipole mass analyzers, quadrupole ion sources, quadrupole electrode spectrometers, collision cells, lenses and lens stacks, stacked filters such as serial stacked filters, ion traps and collisional cooling, or any devices with multiple electrodes or multiple electrical connections, especially where an electrical signal is applied to more than one electrode or component at the same time. It will be apparent to those skilled in the art that some aspects of the inventions described are more appropriately applicable to some devices than others, depending on the desired end use, precision and accuracy, the cost, and other factors. One or more of the various aspects of these inventions can be combined or omitted to achieve